

## **Appendix D**

### **Hazardous Materials Technical Appendix**



## PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: Current Operations

### Summary of Frequency Inputs

Lifetime 30 years, estimated  
Average oil production, bpd 3000 bpd over lifetime (oil only), estimated

Platform Holly and Pipeline Summary	Current	Current
Scenario	Freq, per year	Lifetime Prob, %
<b>Small Spills</b>		
Holly - Blowouts any	1.42E-02	34.7
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4
Holly - Separator Failure Spill to Ocean - leak	1.98E-03	5.8
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0
Pipeline - leaks	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0
<b>Large Spills</b>		
Holly - Blowouts catastrophic	5.68E-03	15.7
Holly - Wellhead area - rupture	6.28E-05	0.2
Holly - Separator Failure Spill to Ocean - rupture	6.57E-04	2.0
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0
Pipeline - ruptures	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4

Detailed Calculations					
PLATFORM HOLLY					
Description	Base rate	Units	Multiplier	Rate	Ref
Holly - Blowouts catastrophic				5.68E-03	
Holly - Blowouts any				1.42E-02	
Number of wells			24		Venoco Application 2005
Blowout during drilling - re-drills	4.84E-03	per well drilled	1.6	7.74E-03	MMS, 93% wellhead or drill floor, estimated redrills based on once every 15 years per well (as per paredon Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills below, platform release	3.64E-04	per well drilled	1.6	5.82E-04	MMS, 7% subsea
Blowout during well workover	9.70E-05	per well	24	2.33E-03	HLID, 1992, gas well workovers, 93% wellhead or drill floor, workovers every 7 years per well
Blowout during well workover: below platform release	7.30E-06	per well	24	1.75E-04	HLID, 1992, gas well workovers, 7% subsea, assumes workovers every 7 years per well
Blowout during production	1.09E-04	per year	24	2.62E-03	HLID 1992, gas well production, 78% wellhead or drill floor, Assumes gas lift wells under reservoir pressure
Blowout during production: below platform release	3.08E-05	per year	24	7.39E-04	HLID 1992, gas well production, 22% subsea, Assumes gas lift wells under reservoir pressure
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS
Holly - Wellhead Area Spill to Ocean - leak				2.21E-03	
Holly - Wellhead Area Spill to Ocean - rupture				6.28E-05	note: no drain system credit taken
Number of wellheads	24	number	1	2.40E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, piping after wells heads to separators, per well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to separators, per well
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, after SSV to separators, per well
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25	2.25E-05	Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant, per well
Pipe rupture - before SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05	/valve.yr	6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic rupture, per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	Rijnmond 1981, riser piping, no platform drain system protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform drain system protection, pipe length to ocean floor
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	Lees, on demand failure to close, increased by 10 for sub surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	

# PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: Current Operations

Description	Base rate	Units	Multiplier	Rate	Ref
<b>Holly - Separator Failure Spill to Ocean - leak</b>				<b>1.98E-03</b>	
<b>Holly - Separator Failure Spill to Ocean - rupture</b>				<b>6.57E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	HLID, 10% rupture, 2 separators
Valve rupture	2.30E-05	/valve.yr	24	5.52E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	estimated
Vessel leak	3.00E-04	per year	2	6.00E-04	
Break of small fitting	4.70E-04	per year	48	2.26E-02	estimated as twice the number of valves
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	24	4.97E-03	
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Pumping and Shipping Spill to Ocean - leak</b>				<b>3.53E-02</b>	
<b>Holly - Pumping and Shipping Spill to Ocean - rupture</b>				<b>5.19E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	2 surge vessels
Valve rupture	2.30E-05	/valve.yr	18	4.14E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	
Break of small fitting	4.70E-04	per year	36	1.69E-02	
Vessel leak	3.00E-04	per year	2	6.00E-04	
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	18	3.73E-03	
Pump leak or rupture	1.70E-02	per year	2	3.40E-02	HLID, 1992
Valve line-up error during pigging	0.01	probability per task	1	1.00E-02	Fail to reset valve: RM&IP
Incorrect reading of a gauge during pigging	4.50E-03	probability per task	1	4.50E-03	Rijnmond, 1981
Pigging operations per year	34	number	1	34	Project description
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Diesel Fuel Loading - Spill to Ocean</b>				<b>2.29E-01</b>	
Hose failure	5.00E-03	per year	1	5.00E-03	CCPS, hose rupture
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Improper correction of linkage	4.40E-03	on demand	1	4.40E-03	Rijnmond, incorrect hose connection
<b>Holly - External impact</b>				<b>1.00E-05</b>	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
<b>Holly - General human error small misc material spills</b>	<b>2.73E-01</b>	<b>per year</b>	<b>1</b>	<b>2.73E-01</b>	Based on historical data of smaller spills, 3 smaller spills over 11 years
<b>Holly - Failure of drainage system</b>				<b>6.40E-02</b>	
High wind	4.20E-02	per demand	1	4.20E-02	Based on NOAA buoy 46053 > 20 mph
Valve fails opened/passes by	3.00E-04	per demand	3	9.00E-04	Rijnmond, leakage, 3 valves NC to water outfall
Tank T-4 or T-1 level alarm/switch failure	3.00E-04	per demand	1	3.00E-04	Lees, limit switches
Pump failure	1.86E-02		1	1.86E-02	CCPS, pump fails to start
PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, failure of control valve per demand
<b>PIPELINE</b>				<b>Freq/yr</b>	<b>Probability</b>
<b>Emulsion Pipeline - Failure rates</b>					
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				3.64E-02	66.4
CSFM for this pipeline, rupture	2.52E-03	per mile-year	3.03	7.64E-03	20.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	3.03	2.70E-03	7.8
MMS pipeline throughput method, >50 bbl spill, per year				6.35E-03	17.3
<b>Pipeline Wave Impact on Beach</b>					
Severe wave impact	5.00E-01	/yr	1	5.00E-01	Wave height greater than 4.5 meters. Frequency based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	Estimated. Once per 10 years potential damage has occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	Once per 10 years potential damage has occurred and 90% to leak.
<b>SCADA - failure</b>				<b>1.01E-01</b>	<b>Reference</b>
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnmond, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnmond, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	R&MIP, Fail to recognize incorrect status on inspection

**PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: Current Operations**

<b>Rates and Age Factors</b>				
Piping Failure Rate: Rupture		4.50E-07	Average between WASH, Rijnmond, Lees and CCPS	
Piping Failure Rate: Leak		2.83E-05	Average between WASH, Rijnmond, Lees and CCPS	
Piping Failure Rate: Rupture - adverse environment		8.80E-07	High value between WASH, Rijnmond, Lees and CCPS.	
Piping Failure Rate: Leak - adverse environment		7.00E-05	High value between WASH, Rijnmond, Lees and CCPS	
PSV lifts light		4.25E-02	Average value of WASH, Rijnmond, Lees and CCPS	
PSV fraction of light lift that are wide open		0.1	Estimated based on general leak/rupture estimate of 10%.	
Rule 331 Inspection Frequency		6	times/yr	based on Venoco info
PSV inspection frequency		1	times/yr	based on Venoco info
Piping age factor		2.0		Based on SPLIC data,
Vessel/Heat Exchanger age factor		2.0		Based on SPLIC data,

## Platform Holly, Offshore Pipeline and Onshore Pipeline Failure Rate Calculations: Proposed Project

### Summary of Frequency Inputs

Lifetime 30 years, estimated  
Average oil production, bpd 6150 bpd over lifetime (oil only), estimated as 1/2 of peak production

Platform Holly and Pipeline Summary	Current	Current	Proposed	Proposed
Scenario	Freq, per year	Lifetime Prob, %	Freq, per year	Lifetime Prob, %
<b>Holly and Offshore Pipeline</b>				
<b>Small Spills</b>				
Holly - Blowouts any	1.42E-02	34.7	2.81E-02	57.0
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4	2.76E-03	8.0
Holly - Separator Failure Spill to Ocean - leak	1.98E-03	5.8	1.98E-03	5.8
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0	2.73E-01	100.0
Pipeline: Emulsion offshore - leaks	3.93E-02	69.2	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0	6.10E-01	100.0
<b>Large Spills</b>				
Holly - Blowouts catastrophic	5.68E-03	15.7	1.10E-02	28.2
Holly - Wellhead area - rupture	6.28E-05	0.2	7.84E-05	0.2
Holly - Separator Failure Spill to Ocean - rupture	6.57E-04	2.0	6.57E-04	2.0
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0	1.00E-05	0.0
Pipeline: Emulsion offshore - ruptures	8.14E-03	21.7	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4	2.04E-02	45.8
<b>Onshore Pipeline</b>				
Pipeline: EOF-AACP - leaks	na	na	3.25E-02	62
Pipeline: EOF-AACP - ruptures	na	na	7.15E-03	19

Detailed Calculations					
<b>PLATFORM HOLLY</b>					
<b>Description</b>	<b>Base rate</b>	<b>Units</b>	<b>Multiplier</b>	<b>Rate</b>	<b>Ref</b>
Holly - Blowouts catastrophic				1.10E-02	
Holly - Blowouts any				2.81E-02	
Number of wells			30		Venoco Application 2005, assumes all slots are active
Blowout during drilling: new wells	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, an estimated average of 3 wells per year drilled during the drilling phase
Blowout during drilling: new wells, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during drilling: re-drills	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, estimated redrills based on once every 15 years per well (as per paredon Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during well workover	9.70E-05	per well	30	2.91E-03	HLID, 1992, gas well workovers, 93% wellhead or drill floor, workovers every 7 years per well
Blowout during well workover: below platform release	7.30E-06	per well	30	2.19E-04	HLID, 1992, gas well workovers, 7% subsea, assumes workovers every 7 years per well
Blowout during production	1.09E-04	per year	30	3.28E-03	HLID 1992, gas well production, 78% wellhead or drill floor, Assumes gas lift wells under reservoir pressure. Eventual conversion to ESP not included.
Blowout during production: below platform release	3.08E-05	per year	30	9.24E-04	HLID 1992, gas well production, 22% subsea, Assumes gas lift wells under reservoir pressure.
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS

**Platform Holly, Offshore Pipeline and Onshore Pipeline Failure Rate Calculations: Proposed Project**

<i>Description</i>	<i>Base rate</i>	<i>Units</i>	<i>Multiplier</i>	<i>Rate</i>	<i>Ref</i>
<b>Holly - Wellhead Area Spill to Ocean - leak</b>				<b>2.76E-03</b>	
<b>Holly - Wellhead Area Spill to Ocean - rupture</b>				<b>7.84E-05</b>	note: no drain system credit taken
Number of wellheads	30	number	1	3.00E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, piping after wells heads to separators, per well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to separators, per well
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, after SSV to separators, per well
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25	2.25E-05	Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant, per well
Pipe rupture - before SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05	/valve.yr	6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic rupture, per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	Rijnmond 1981, riser piping, no platform drain system protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform drain system protection, pipe length to ocean floor
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	Lees, on demand failure to close, increased by 10 for sub surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Separator Failure Spill to Ocean - leak</b>				<b>1.98E-03</b>	
<b>Holly - Separator Failure Spill to Ocean - rupture</b>				<b>6.57E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	HLID, 10% rupture, 2 separators
Valve rupture	2.30E-05	/valve.yr	24	5.52E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	estimated
Vessel leak	3.00E-04	per year	2	6.00E-04	
Break of small fitting	4.70E-04	per year	48	2.26E-02	estimated as twice the number of valves
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	24	4.97E-03	
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Pumping and Shipping Spill to Ocean - leak</b>				<b>3.53E-02</b>	
<b>Holly - Pumping and Shipping Spill to Ocean - rupture</b>				<b>5.19E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	2 surge vessels
Valve rupture	2.30E-05	/valve.yr	18	4.14E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	
Break of small fitting	4.70E-04	per year	36	1.69E-02	
Vessel leak	3.00E-04	per year	2	6.00E-04	
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	18	3.73E-03	
Pump leak or rupture	1.70E-02	per year	2	3.40E-02	HLID, 1992
Valve line-up error during pigging	0.01	probability per task	1	1.00E-02	Fail to reset valve: RM&IP
Incorrect reading of a gauge during pigging	4.50E-03	probability per task	1	4.50E-03	Rijnmond, 1981
Pigging operations per year	34	number	1	34	Project description
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Diesel Fuel Loading - Spill to Ocean</b>				<b>2.29E-01</b>	
Hose failure	5.00E-03	per year	1	5.00E-03	CCPS, hose rupture
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Improper correction of linkage	4.40E-03	on demand	1	4.40E-03	Rijnmond, incorrect hose connection
<b>Holly - External impact</b>				<b>1.00E-05</b>	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
<b>Holly - General human error small misc material spills</b>	<b>2.73E-01</b>	<b>per year</b>	<b>1</b>	<b>2.73E-01</b>	Based on historical data of smaller spills, 3 smaller spills over 11 years
<b>Holly - Failure of drainage system</b>				<b>6.40E-02</b>	
High wind	4.20E-02	per demand	1	4.20E-02	Based on NOAA buoy 46053 > 20 mph
Valve fails opened/passes by	3.00E-04	per demand	3	9.00E-04	Rijnmond, leakage, 3 valves NC to water outfall
Tank T-4 or T-1 level alarm/switch failure	3.00E-04	per demand	1	3.00E-04	Lees, limit switches
Pump failure	1.86E-02		1	1.86E-02	CCPS, pump fails to start
PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, failure of control valve per demand

**Platform Holly, Offshore Pipeline and Onshore Pipeline Failure Rate Calculations: Proposed Project**

<b>PIPELINES</b>				<b>Freq/yr</b>	<b>Probability</b>
<i>Description</i>	<i>Base rate</i>	<i>Units</i>	<i>Multiplier</i>	<i>Rate</i>	<i>Ref</i>
<b>Emulsion Pipeline - Failure rates</b>					
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	2.52E-03	per mile-year	3.03	7.64E-03	20.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	3.03	2.70E-03	7.8
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
<b>Pipeline Wave Impact on Beach</b>					
Severe wave impact	5.00E-01	/yr	1	5.00E-01	Wave height greater than 4.5 meters. Frequency based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	Estimated. Once per 10 years potential damage has occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	Once per 10 years potential damage has occurred and 90% to leak.
<b>Onshore EOF- AACP Pipeline - Failure rates</b>					
CSFM for this pipeline, leak	3.83E-03	per mile-year	8.50	3.25E-02	62.3
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	8.41E-04	per mile-year	8.50	7.15E-03	19.3
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	8.50	7.57E-03	20.3
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
<b>SCADA - failure</b>				<b>1.01E-01</b>	<b>Reference</b>
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	R&MIP, Fail to recognize incorrect status on inspection



## PLATFORM HOLLY and Onshore Pipeline Failure Rate Calculations: Holly Processing Alternative

### Summary of Frequency Inputs

Lifetime 30 years, estimated  
Average oil production, bpd 6150 bpd over lifetime (oil only), estimated as 1/2 of peak production

Platform Holly and Pipeline Summary	Current	Current	Proposed	Proposed
Scenario	Freq, per year	Lifetime Prob, %	Freq, per year	Lifetime Prob, %
<b>Holly and Offshore Pipeline</b>				
<b>Small Spills</b>				
Holly - Blowouts any	1.42E-02	34.7	2.81E-02	57.0
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4	2.21E-03	6.4
Holly - Separator/Oil Processing Failure Spill to Ocean - leak	1.98E-03	5.8	7.87E-03	21.0
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0	2.73E-01	100.0
Pipeline: Emulsion offshore - leaks	3.93E-02	69.2	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0	6.15E-01	100.0
<b>Large Spills</b>				
Holly - Blowouts catastrophic	5.68E-03	15.7	1.10E-02	28.2
Holly - Wellhead area - rupture	6.28E-05	0.2	6.28E-05	0.2
Holly - Separator/Oil Processing Failure Spill to Ocean - rupture	6.57E-04	2.0	2.57E-03	7.4
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0	1.00E-05	0.0
Pipeline: Emulsion offshore - ruptures	8.14E-03	21.7	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4	2.23E-02	48.8
<b>Onshore Pipeline</b>				
Pipeline: EOF-AACP - leaks	na	na	3.25E-02	62.3
Pipeline: EOF-AACP - ruptures	na	na	7.15E-03	19.3

### Detailed Calculations

PLATFORM HOLLY					
Description	Base rate	Units	Multiplier	Rate	Ref
<b>Holly - Blowouts catastrophic</b>				<b>1.10E-02</b>	
<b>Holly - Blowouts any</b>				<b>2.81E-02</b>	
Number of wells			30		Venoco Application 2005, assumes all slots are active
Blowout during drilling: new wells	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, an estimated average of 3 wells per year drilled during the drilling phase
Blowout during drilling: new wells, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during drilling: re-drills	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, estimated redrills based on once every 15 years per well (as per paredon Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during well workover	9.70E-05	per well	30	2.91E-03	HLID, 1992, gas well workovers, 93% wellhead or drill floor, workovers every 7 years per well
Blowout during well workover: below platform release	7.30E-06	per well	30	2.19E-04	HLID, 1992, gas well workovers, 7% subsea, assumes workovers every 7 years per well
Blowout during production	1.09E-04	per year	30	3.28E-03	HLID 1992, gas well production, 78% wellhead or drill floor, Assumes gas lift wells under reservoir pressure. Eventual conversion to ESP not included.
Blowout during production: below platform release	3.08E-05	per year	30	9.24E-04	HLID 1992, gas well production, 22% subsea, Assumes no production wells under reservoir pressure
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS

**PLATFORM HOLLY and Onshore Pipeline Failure Rate Calculations: Holly Processing Alternative**

<i>Description</i>	<i>Base rate</i>	<i>Units</i>	<i>Multiplier</i>	<i>Rate</i>	<i>Ref</i>
<b>Holly - Wellhead Area Spill to Ocean - leak</b>				<b>2.21E-03</b>	
<b>Holly - Wellhead Area Spill to Ocean - rupture</b>				<b>6.28E-05</b>	note: no drain system credit taken
Number of wellheads	24	number	1	2.40E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, piping after wells heads to separators, per well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to separators, per well
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, after SSV to separators, per well
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25	2.25E-05	Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant, per well
Pipe rupture - before SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05	/valve.yr	6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic rupture, per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	Rijnmond 1981, riser piping, no platform drain system protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform drain system protection, pipe length to ocean floor
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	Lees, on demand failure to close, increased by 10 for sub surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Separator/Oil Processing Failure Spill to Ocean - leak</b>				<b>7.87E-03</b>	
<b>Holly - Separator/Oil Processing Failure Spill to Ocean - rupture</b>				<b>2.57E-03</b>	
Vessel Rupture	3.00E-05	per year	4	1.20E-04	HLID, 10% rupture, 2 separators, 2 vessels
Heat exchanger rupture	1.49E-05	per year	4	5.96E-05	HLID, 10% rupture, 4 exchangers including thermisol
Valve rupture	2.30E-05	/valve.yr	96	2.21E-03	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	200	1.80E-04	estimated pipe lengths at 25m per vessel/exchanger
Vessel leak	3.00E-04	per year	4	1.20E-03	
Heat exchanger leak	1.49E-04	per year	2	2.98E-04	HLID, 90% leak
Break of small fitting	4.70E-04	per year	192	9.02E-02	estimated as twice the number of valves
Pipe leak	5.66E-05	/m.yr	200	1.13E-02	
Valve leak	2.07E-04	/valve.yr	96	1.99E-02	
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Pumping and Shipping Spill to Ocean - leak</b>				<b>3.53E-02</b>	
<b>Holly - Pumping and Shipping Spill to Ocean - rupture</b>				<b>5.19E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	2 surge vessels
Valve rupture	2.30E-05	/valve.yr	18	4.14E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	
Break of small fitting	4.70E-04	per year	36	1.69E-02	
Vessel leak	3.00E-04	per year	2	6.00E-04	
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	18	3.73E-03	
Pump leak or rupture	1.70E-02	per year	2	3.40E-02	HLID, 1992
Valve line-up error during pigging	0.01	probability per task	1	1.00E-02	Fail to reset valve: RM&IP
Incorrect reading of a gauge during pigging	4.50E-03	probability per task	1	4.50E-03	Rijnmond, 1981
Pigging operations per year	34	number	1	34	Project description
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Diesel Fuel Loading - Spill to Ocean</b>				<b>2.29E-01</b>	
Hose failure	5.00E-03	per year	1	5.00E-03	CCPS, hose rupture
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Improper correction of linkage	4.40E-03	on demand	1	4.40E-03	Rijnmond, incorrect hose connection

**PLATFORM HOLLY and Onshore Pipeline Failure Rate Calculations: Holly Processing Alternative**

<i>Description</i>	<i>Base rate</i>	<i>Units</i>	<i>Multiplier</i>	<i>Rate</i>	<i>Ref</i>
<b>Holly - External impact</b>				<b>1.00E-05</b>	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
<b>Holly - General human error small misc material spills</b>	<b>2.73E-01</b>	<b>per year</b>	<b>1</b>	<b>2.73E-01</b>	Based on historical data of smaller spills, 3 smaller spills over 11 years
<b>Holly - Failure of drainage system</b>				<b>6.40E-02</b>	
High wind	4.20E-02	per demand	1	4.20E-02	Based on NOAA buoy 46053 > 20 mph
Valve fails opened/passes by	3.00E-04	per demand	3	9.00E-04	Rijnmond, leakage, 3 valves NC to water outfall
Tank T-4 or T-1 level alarm/switch failure	3.00E-04	per demand	1	3.00E-04	Lees, limit switches
Pump failure	1.86E-02		1	1.86E-02	CCPS, pump fails to start
PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, failure of control valve per demand
<b>PIPELINE</b>				<b>Freq/yr</b>	<b>Probability</b>
<b>Emulsion Pipeline - Failure rates</b>					
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	2.52E-03	per mile-year	3.03	7.64E-03	20.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	3.03	2.70E-03	7.8
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
<b>Pipeline Wave Impact on Beach</b>					
Severe wave impact	5.00E-01	/yr	1	5.00E-01	Wave height greater than 4.5 meters. Frequency based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	Estimated. Once per 10 years potential damage has occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	90% to leak.
<b>Onshore EOF- AACP Pipeline - Failure rates</b>					
CSFM for this pipeline, leak	3.83E-03	per mile-year	8.50	3.25E-02	62.3
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	8.41E-04	per mile-year	8.50	7.15E-03	19.3
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	8.50	7.57E-03	20.3
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
<b>SCADA - failure</b>				<b>1.01E-01</b>	<b>Reference</b>
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnmond, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnmond, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	R&MIP, Fail to recognize incorrect status on inspection

## PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: LFC Offshore Pipeline

### Summary of Frequency Inputs

Lifetime 30 years, estimated  
Average oil production, bpd 6150 bpd over lifetime (oil only), estimated as 1/2 of peak production

Platform Holly and Pipeline Summary	Current	Current	LFC Alt	LFC Alt
Scenario	Freq, per year	Lifetime Prob, %	Freq, per year	Lifetime Prob, %
<b>Small Spills</b>				
Holly - Blowouts any	1.42E-02	34.7	2.81E-02	57.0
Holly - Wellhead Area Spill to Ocean - leak	2.21E-03	6.4	2.76E-03	8.0
Holly - Separator Failure Spill to Ocean - leak	1.98E-03	5.8	1.98E-03	5.8
Holly - Pumping and Shipping Spill to Ocean - leak	3.53E-02	65.3	3.53E-02	65.3
Holly - Diesel Fuel Loading - Spill to Ocean	2.29E-01	99.9	2.29E-01	99.9
Holly - misc material spills	2.73E-01	100.0	2.73E-01	100.0
Pipeline: Emulsion offshore - leaks	3.93E-02	69.2	3.93E-02	69.2
Cumulative Small Spills	5.95E-01	100.0	6.10E-01	100.0
<b>Large Spills</b>				
Holly - Blowouts catastrophic	5.68E-03	15.7	1.10E-02	28.2
Holly - Wellhead area - rupture	6.28E-05	0.2	7.84E-05	0.2
Holly - Separator Failure Spill to Ocean - rupture	6.57E-04	2.0	6.57E-04	2.0
Holly - Pumping and Shipping Spill to Ocean - rupture	5.19E-04	1.5	5.19E-04	1.5
Holly - External impact	1.00E-05	0.0	1.00E-05	0.0
Pipeline: Emulsion offshore - ruptures	8.14E-03	21.7	8.14E-03	21.7
Cumulative Large Spills	1.51E-02	36.4	2.04E-02	45.8
<b>Pipeline Holly - LFC</b>				
Pipeline: Holly LFC - leaks	na	na	4.06E-02	70
Pipeline: Holly LFC - ruptures	na	na	8.91E-03	23

Detailed Calculations					
<b>PLATFORM HOLLY</b>					
<b>Description</b>	<b>Base rate</b>	<b>Units</b>	<b>Multiplier</b>	<b>Rate</b>	<b>Ref</b>
<b>Holly - Blowouts catastrophic</b>				<b>1.10E-02</b>	
<b>Holly - Blowouts any</b>				<b>2.81E-02</b>	
Number of wells			30		Venoco Application 2005, assumes all slots are active
Blowout during drilling: new wells	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, an estimated average of 3 wells per year drilled during the drilling phase
Blowout during drilling: new wells, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during drilling: re-drills	4.84E-03	per well drilled	2	9.67E-03	MMS, 93% wellhead or drill floor, estimated redrills based on once every 15 years per well (as per paredon Application, 2 redrills/year for approx 30 wells)
Blowout during drilling: re-drills, below platform release	3.64E-04	per well drilled	2	7.28E-04	MMS, 7% subsea
Blowout during well workover	9.70E-05	per well	30	2.91E-03	HLID, 1992, gas well workovers, 93% wellhead or drill floor, workovers every 7 years per well
Blowout during well workover: below platform release	7.30E-06	per well	30	2.19E-04	HLID, 1992, gas well workovers, 7% subsea, assumes workovers every 7 years per well
Blowout during production	1.09E-04	per year	30	3.28E-03	HLID 1992, gas well production, 78% wellhead or drill floor, Assumes gas lift wells under reservoir pressure. Eventual conversion to ESP not included.
Blowout during production: below platform release	3.08E-05	per year	30	9.24E-04	HLID 1992, gas well production, 22% subsea, Assumes gas lift wells under reservoir pressure.
Oil spill conditional probability	3.30E-01	per demand	1	3.30E-01	Catastrophic well blowout, MMS

# **PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: LFC Offshore Pipeline**

<b>Holly - Wellhead Area Spill to Ocean - leak</b>				<b>2.76E-03</b>	
<b>Holly - Wellhead Area Spill to Ocean - rupture</b>				<b>7.84E-05</b>	note: no drain system credit taken
Number of wellheads	30	number	1	3.00E+01	Current operation
Break of small fitting - after SSV	4.70E-04	per year	3	1.41E-03	HLID, 3 fittings per well
Pipe leak - after SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, piping after wells heads to separators, per well
Pipe leak - after SSV - header	5.66E-05	/m.yr	25	1.42E-03	Rijnmond 1981, piping after headers to separators
Valve leak - after SSV	2.07E-04	/valve.yr	3	6.21E-04	HLID, Assume 90% are leaks, valves after SSV to separators, per well
Pipe rupture - after SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, after SSV to separators, per well
Pipe rupture - after SSV - header	9.00E-07	/m.yr	25	2.25E-05	Rijnmond, Rupture of pipe, header to separators
Valve rupture - after SSV	2.30E-05	/valve.yr	3	6.90E-05	HLID, Assume 10% of leaks are rupture, after SSV to separators, per well
Pipe leak - before SSV	5.66E-05	/m.yr	10	5.66E-04	Rijnmond 1981, before SSV, per well
Valve leak - before SSV	2.07E-04	/valve.yr	6	1.24E-03	Rijnmond 1981 Assume 90% of leaks are significant, per well
Pipe rupture - before SSV	9.00E-07	/m.yr	10	9.00E-06	Rijnmond, Rupture of pipe, per well
Valve rupture - before SSV	2.30E-05	/valve.yr	6	1.38E-04	Rijnmond, Assume 10% of leaks are catastrophic rupture, per well
Pipe leak - under Platform	1.40E-04	/m.yr	65	9.10E-03	Rijnmond 1981, riser piping, no platform drain system protection, pipe length to ocean floor
Pipe rupture - under Platform	1.76E-06	/m.yr	65	1.14E-04	Rijnmond, Rupture of pipe, riser piping, no platform drain system protection, pipe length to ocean floor
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	Lees, on demand failure to close, increased by 10 for sub surface service
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	Lees, on demand failure to close
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Separator Failure Spill to Ocean - leak</b>				<b>1.98E-03</b>	
<b>Holly - Separator Failure Spill to Ocean - rupture</b>				<b>6.57E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	HLID, 10% rupture, 2 separators
Valve rupture	2.30E-05	/valve.yr	24	5.52E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	estimated
Vessel leak	3.00E-04	per year	2	6.00E-04	
Break of small fitting	4.70E-04	per year	48	2.26E-02	estimated as twice the number of valves
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	24	4.97E-03	
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Pumping and Shipping Spill to Ocean - leak</b>				<b>3.53E-02</b>	
<b>Holly - Pumping and Shipping Spill to Ocean - rupture</b>				<b>5.19E-04</b>	
Vessel Rupture	3.00E-05	per year	2	6.00E-05	2 surge vessels
Valve rupture	2.30E-05	/valve.yr	18	4.14E-04	2" valves and greater
Pipe rupture	9.00E-07	/m.yr	50	4.50E-05	
Break of small fitting	4.70E-04	per year	36	1.69E-02	
Vessel leak	3.00E-04	per year	2	6.00E-04	
Pipe leak	5.66E-05	/m.yr	50	2.83E-03	
Valve leak	2.07E-04	/valve.yr	18	3.73E-03	
Pump leak or rupture	1.70E-02	per year	2	3.40E-02	HLID, 1992
Valve line-up error during pigging	0.01	probability per	1	1.00E-02	Fail to reset valve: RM&IP
Incorrect reading of a gauge during pigging	4.50E-03	probability per	1	4.50E-03	Rijnmond, 1981
Pigging operations per year	34	number	1	34	Project description
Failure of drainage system	6.40E-02	on demand	1	6.40E-02	
<b>Holly - Diesel Fuel Loading - Spill to Ocean</b>				<b>2.29E-01</b>	
Hose failure	5.00E-03	per year	1	5.00E-03	CCPS, hose rupture
Loadings per year	5.20E+01	per year	1	5.20E+01	weekly, estimated
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Improper correction of linkage	4.40E-03	on demand	1	4.40E-03	Rijnmond, incorrect hose connection
<b>Holly - External impact</b>				<b>1.00E-05</b>	Pt. Ped Pt. Ped 1985 EIR, Figure 2-10
<b>Holly - General human error small misc material spills</b>	<b>2.73E-01</b>	<b>per year</b>	<b>1</b>	<b>2.73E-01</b>	Based on historical data of smaller spills, 3 smaller spills over 11 years
<b>Holly - Failure of drainage system</b>				<b>6.40E-02</b>	
High wind	4.20E-02	per demand	1	4.20E-02	Based on NOAA buoy 46053 > 20 mph
Valve fails opened/passes by	3.00E-04	per demand	3	9.00E-04	Rijnmond, leakage, 3 valves NC to water outfall
Tank T-4 or T-1 level alarm/switch failure	3.00E-04	per demand	1	3.00E-04	Lees, limit switches
Pump failure	1.86E-02		1	1.86E-02	CCPS, pump fails to start
PCV fails closed/blocked on pump discharge	2.20E-03		1	2.20E-03	CCPS, failure of control valve per demand

**PLATFORM HOLLY and Offshore Pipeline Failure Rate Calculations: LFC Offshore Pipeline**

<b>PIPELINE</b>				<b>Freq/yr</b>	<b>Probability</b>
<b>Emulsion Pipeline Holly-EOF - Failure rates</b>					
Pipeline Rupture				8.14E-03	21.7
Pipeline Leak				3.93E-02	69.2
CSFM for this pipeline, leak	1.15E-02	per mile-year	3.03	3.48E-02	64.8
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	2.52E-03	per mile-year	3.03	7.64E-03	20.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	3.03	2.70E-03	7.8
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
<b>Pipeline Holly-EOF Wave Impact on Beach</b>					
Severe wave impact	5.00E-01	/yr	1	5.00E-01	Wave height greater than 4.5 meters. Frequency based on Bouy 107 Goleta Point 2002-2006.
Operator failure to inspect	1.00E-01	/demand	1	1.00E-01	Failure to recognize incorrect status (RMIP).
Wave impact causes pipeline damage sufficient to rupture	1.00E-02	fraction	1	1.00E-02	Estimated. Once per 10 years potential damage has occurred and 10% to rupture.
Fraction of impacts to leak	9.00E-02	fraction	1	9.00E-02	90% to leak.
<b>Offshore Holly - LFC Pipeline - Failure rates</b>					
CSFM for this pipeline, leak	3.83E-03	per mile-year	10.60	4.06E-02	70.4
MMS pipeline throughput method, <50 bbl spill, per year				7.45E-02	89.3
CSFM for this pipeline, rupture	8.41E-04	per mile-year	10.60	8.91E-03	23.5
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	10.60	9.43E-03	24.6
MMS pipeline throughput method, >50 bbl spill, per year				1.30E-02	32.3
<b>SCADA - failure</b>					
Phone line failure	2.28E-04	demand	1	2.28E-04	<b>Reference</b> Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	R&MIP, Fail to recognize incorrect status on inspection